Space Weather Technical Forecast

Issued on Tuesday, 20 August 2024 at 01:10 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Likelihood of R1/R2 falling slightly later in UTC week, as risk of G1 perhaps rises.

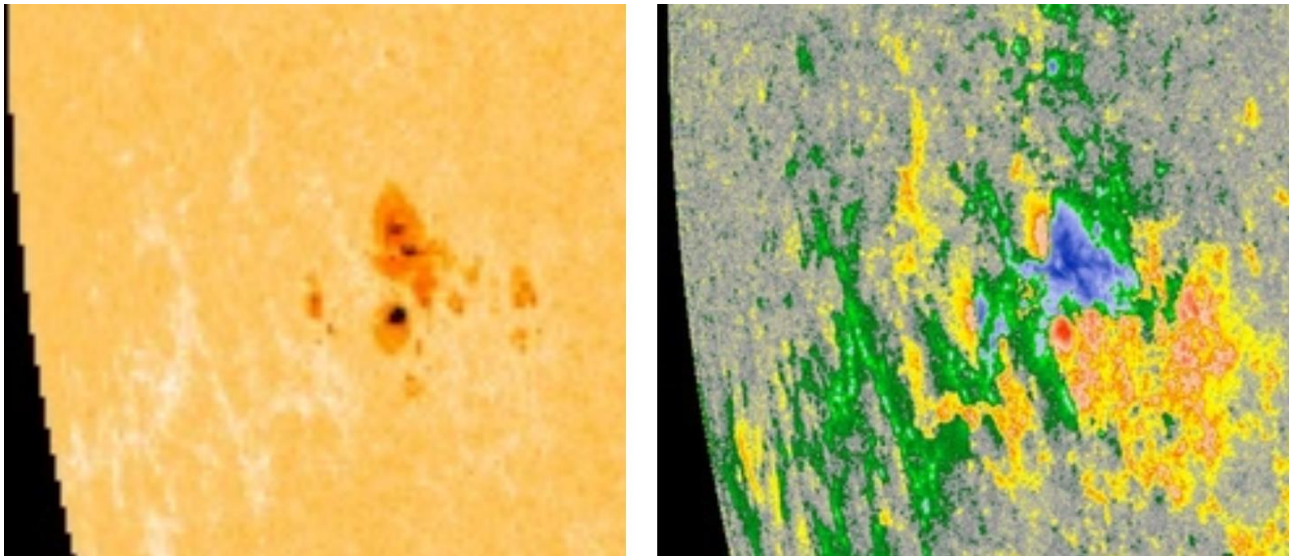
Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity observed at GOES16 was Moderate, with four M-class flares observed, peaking with a doublet M3.7 and M1.0 starting at 19/2152UTC from AR3796 in the far east. Also observed were an M1.4 from AR3796 greeting the UTC day at 19/0000UTC, and an M1.3 at 19/0936UTC from AR3785 in the southwest.

Almost all of the magnetically bipolar regions on the disc showed some form of growth in the period, with this consisting of proliferation of spots and spreading in all but AR3793 in the northeast, which shrank. The most complex regions on the disc are now in the southeast, with two compact groups and polarity mixing in AR3790 and AR3796. AR3784 remains a complex group but is less congested than in recent days, with developments mainly concentrated in outlying minor spots.

Coronagraph imagery for the period showed a number of minor outlying Coronal Mass Ejections (CMEs), however none was confirmed as Earth-directed.

Figure 0: HMIIF and HMIBC imagery from 19/2330UTC showing AR3796 in the southeast quadrant – the sunspot region responsible for the peak flares of the past 24 hours.



Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1 showed a slow regime. The solar wind speed was mainly confined to the upper-300s of km/s, but briefly increased to near 450 around 19/0600UTC. The solar wind density was at background levels throughout in single figures ppcc. The IMF was Slightly Elevated at first with a peak of 9nT, but reduced slightly

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with time. The north-south component was mainly co-aligned with Earth's field during the UTC morning, but became increasingly anti-aligned later in the period, with a range of between +8 and -7nT. The phi angle was positive (away from the Sun).

The net result of the above solar wind measures was provisionally Quiet to Unsettled, with the 09-12UTC and 15-18UTC intervals recording Kps of '3+'.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background.

High energy electron flux (greater than 2MeV) observed at GOES16 was at Normal Background. The 24-hour fluence was below the Active threshold, with 8.18e5 integrated pfu observed at 20/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: M-class flares are Expected until after UTC midweek, whereupon the departure of AR3784 and AR3785 in turn should see a slight dip in daily risks. X-class flares are rated a decreasing Slight Chance over the same timeframe. No significant arrivals are expected.

Solar Wind /Geomagnetic Activity: There are no definitively Earth-directed CMEs, however a high solar latitude CME off the north-disc on 17 August has a slight chance of giving a glancing arrival on day 2 (Wednesday 21 August). This may coincide with the only fast wind due in the four days, CH60/+ into Thursday 22 August, however confidence is low.

Quiet geomagnetic activity should characterise the first half of the UTC week, with an increasing Slight Chance of G1 Minor geomagnetic storms to end it, with this increase of low confidence.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at Background, with a Slight Chance of breaching the S1 Minor solar radiation storm level should any notable flares occur, primarily from AR3784 or AR3785.

High energy electron flux is expected to remain at Normal Background at first, but with a Chance of increasing to Moderate as solar winds ease later in the period. The associated 24-hour fluence is expected to be below the Active level.

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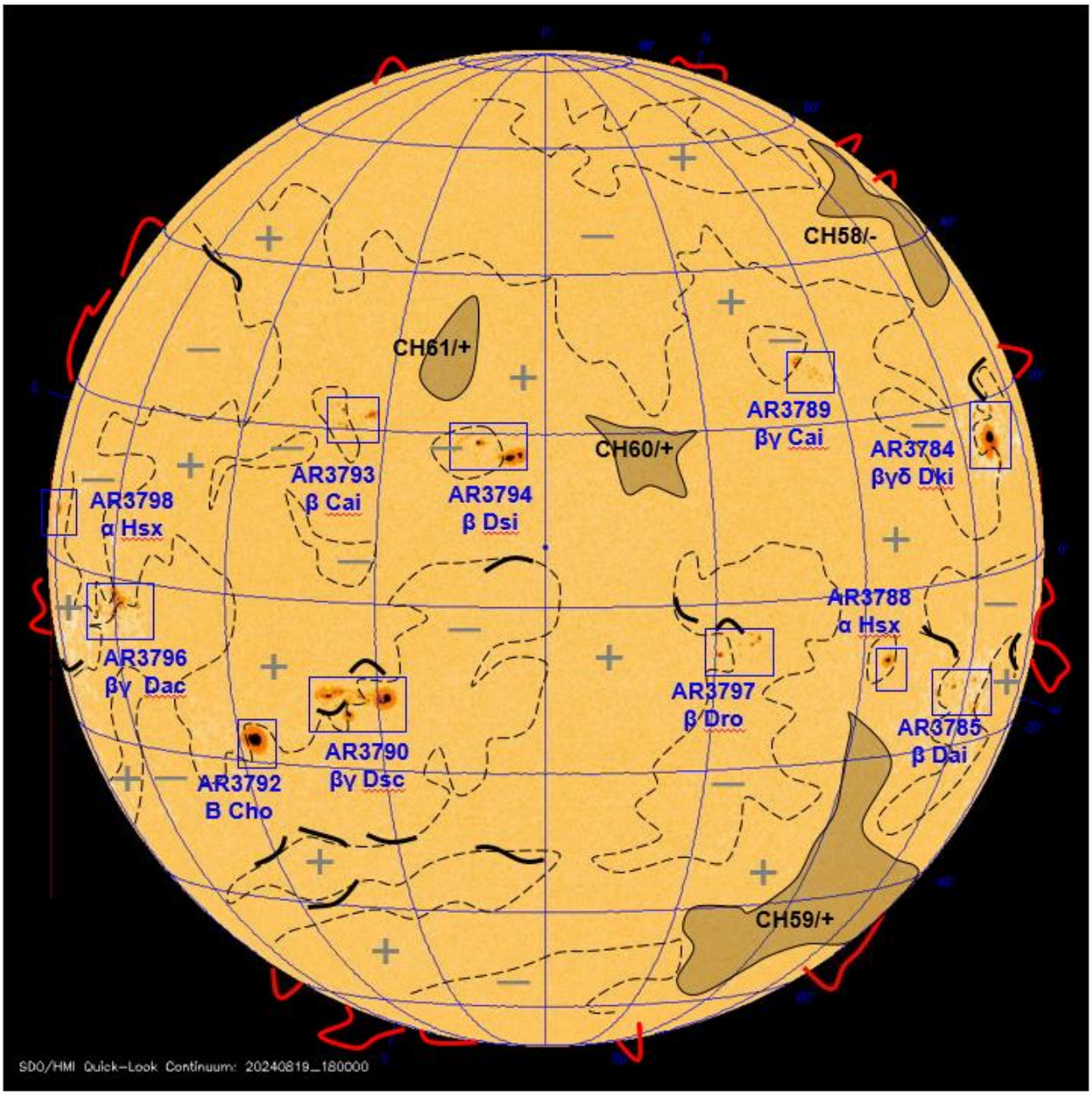
Figure 1. Solar Analysis Valid 19/1800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

The geomagnetic forecast is of lower-than-average confidence in detail for this period, but higher for the expected lack of larger scale events (barring future CMEs). In general, activity is more likely to increase as the period evolves. The reasons for the greater than average uncertainty are: the large number of minor transients observed in coronagraph imagery; the marginal incidence of the only potentially inbound CME; and finally due to the changed shape and non-persistent nature of the only coronal hole to perhaps feature, CH60/+.

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The only CME of note appears to be from a broad upper coronal reconfiguration, occurring around 17/1030UTC across a large span of 40N. This resultant CME is most likely to stay above the ecliptic plane, but has a small chance of giving glancing impacts on day 2 (Wednesday 21 August) - particularly should it interact with the only potential fast wind of the period (from CH60/+).

A slow regime is therefore expected until at least UTC midweek, with a small chance of giving way to Active to G1 Minor Storms late on day 2 (Wednesday 21 August) if any CME glance occurs. Because of the extreme glancing incidence involved, the error bars in any arrival time are very large, and the greatest chance of any effect is perhaps into day 3 and any combined arrival with CH60/+. This coronal hole has visibly shrunk in EUV (e.g. AIA211) in the past 48 hours, however the emanating solar wind that may affect Earth will very likely have already been emitted prior to these changes occurring. While visually small, as a positive feature, and approaching the September equinox, this could result in G1 Minor Storms (Russell-McPherron effect).

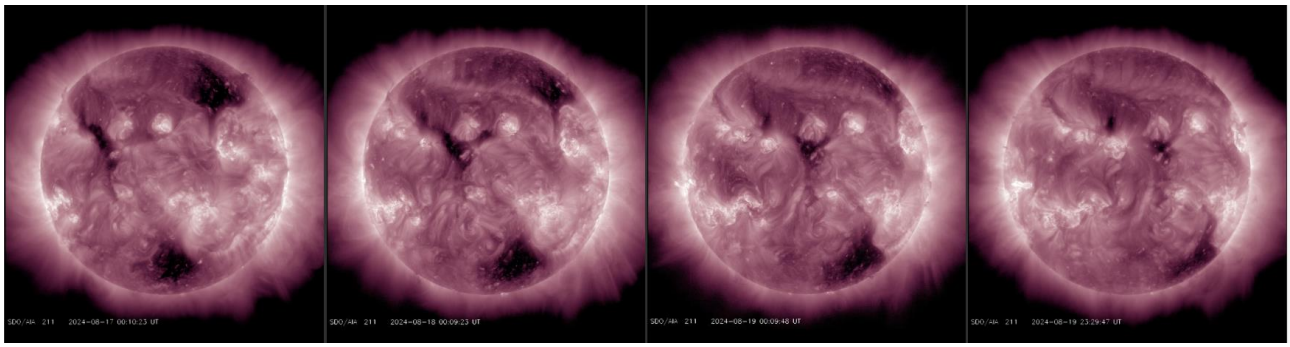

Figure 2: SDO AIA211 imagery sequence for around 00UTC on the days 17 to 20 August inclusive, showing evolution of CH60/+. This feature has changed notably in size and shape over this period, and the character of its emenating wind is therefore of especially low confidence, amplified by it being a non-persistent feature.

A second fast wind from a similarly minor coronal hole (CH61/+) will most likely arrive around 48 hours after the onset of CH60/+, currently thought to encompass the upcoming UTC weekend.

The most reliably Quiet day should be Tuesday 20 August, with a broad Slight Chance of Active or G1 then developing from late on Wednesday 21 August through the remainder of the UTC week.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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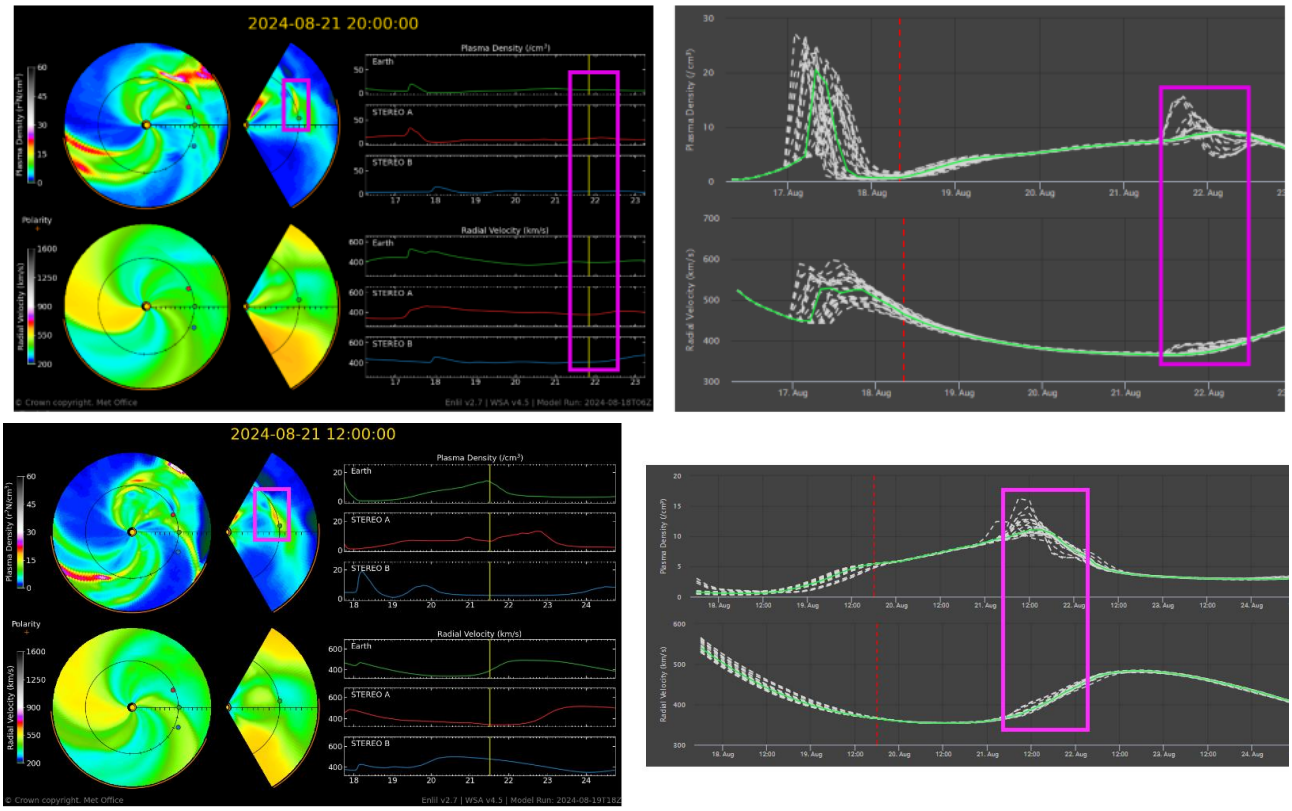
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
17/2001	Partial?	High coronal	40N across centre-disc	368km/s	Crosses 1AU 21/1200UTC	Possibly a miss, but may interact with CH60/+

Figure 2: MOSWOC Enlil and ensemble evolution (badge time 18/0600UTC top; 19/1800UTC bottom). Note that the 1AU crossing time of the 17 August CME has been brought forward by 12 hours, with Enlil showing a more definite enhancement from CH60/+ at Earth from midweek. This is tentatively accepted, however both the CME and fast wind remain relatively low confidence.



Radio Blackouts - X-Ray Flares:

The active region X-ray flare sources seen in the past 24 hours are different from those seen in recent days, and the risk of M-class flares is unusually well-spread amongst the eleven sunspot regions, giving relatively stable M- and X-class probabilities that are not reliant on any one group.

The main sunspot regions on the disc are perhaps the two Zurich compact regions in the southeast: AR3790, which is a Dsc/BG, and AR3796 which is a Dac/BG. Both are showing congested centres and potential for small Mt Wilson delta spot development. The western solar hemisphere is also contributing AR3784, which is assessed as a Dki/BGD, although the large delta has fewer, more distant peripheral spots than of late. AR3785 currently appears as a Dai/B, although the viewing angle is making analysis of any detail here increasingly difficult.

The trend in X-ray activity should be slightly downward over the four days as AR3784 and then

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AR3785 rotate off the disc after UTC midweek, with departures dominating as little is signalled to arrive over the eastern horizon from far-side soundings and returning Carringtons.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	Yes	80	80	75	70
Very Active	**R3 to R5 X Class**	No	20	20	15	15

Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is expected to persist at Background levels, but with a chance of rising in response to any notable flares.

There have been no recent enhancements in the near-Earth environment, this despite a steady cadence of low-level M-class flares over the past several days and beyond. While not the most complex or active regions on the disc, the main proton risk remains from AR3784 and perhaps now also AR3785 which are both approaching the western limb, with that from Ex-AR3780 now largely faded.

The more threatening active regions currently lie well to the east and it will be some days yet before they play an appreciable role in the risk of S1+, with the overall risk therefore a declining Slight Chance after UTC midweek.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	15	15
Very Active	**≥ S3 ***	No	5	5	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):

The high energy electron forecast is of low confidence, but likely little import. Current Normal Background levels should show an uptick within the first 24 hours as the outer Van Allen belt perhaps restores to encompass GEO, with diurnal Moderate levels becoming increasingly Likely. Despite this increase, the chances of 24-hour integrated Active fluence are still deemed low, and may possibly be interrupted by minor geomagnetic activity later in the coming UTC working week.

MOSWOC REFM is not felt likely to offer useful guidance in its 72-hour range, owing to the non-persistent nature of CH60/+ and the possible presence of a glancing incidence (17 August) CME.

GEO Electron Environment	**Level (cm^{-2} sr^{-1} day^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC)**	**Day 2 (00-24 UTC)**	**Day 3 (00-24 UTC)**	**Day 4 (00-24 UTC)**
Probability (Exceedance)			**(%)**	**(%)**	**(%)**	**(%)**
Active	**≥ 2 MeV ≥ $1x10^{8}$**	No	1	5	5	1
Very Active	**≥ 2 MeV ≥ $1x10^{9}$**	No	1	1	1	1

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